



**Coimisiún na Scrúduithe Stáit  
State Examinations Commission**

**LEAVING CERTIFICATE EXAMINATION, 2010**

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**ENGINEERING – MATERIALS AND TECHNOLOGY**

(Higher level – 300 marks)

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**THURSDAY, 10 JUNE**

**MORNING 9:30 – 12:30**

## **INSTRUCTIONS**

- 1.** Answer **Sections A and B of Question 1** and **FOUR** other questions.
- 2.** All answers must be written in ink on the answer book supplied.
- 3.** Diagrams should be drawn in pencil.
- 4.** Squared paper is supplied for diagrams and graphs as required.
- 5.** Please label and number carefully each question attempted.

Question 1.

(100 marks)

Section A – 50 Marks

Give **brief answers** to **any ten** of the following:

- (a) State the purpose of **any two** of the safety signs shown.



(i)

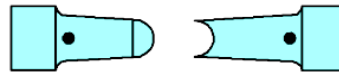


(ii)



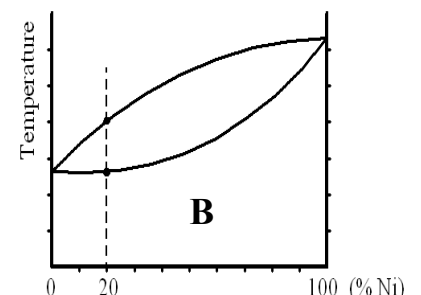
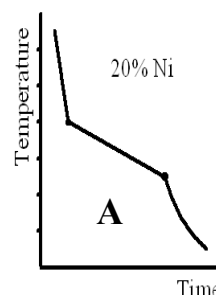
(iii)

- (b) Describe flotation separation as a method of ore dressing.
- (c) Outline **two** reasons for the use of models **or** prototypes in the design and manufacture of cars.
- (d) Identify **any two** finishing treatments that may be applied to mild steel to protect against corrosion.
- (e) Describe the type of fracture in the tensile test specimen shown.



- (f) State **any three** common applications of pneumatic control.
- (g) Select **any two** of the abbreviations shown and explain their meaning:  
(i) LED      (ii) IC      (iii) http      (iv) DVD.
- (h) Outline the safety precautions to prevent *rancidity* when using cutting fluids.
- (i) What contribution did **any one** of the following make to technology?  
(i) Steve Jobs      (ii) John Logie Baird      (iii) John P. Holland.
- (j) Outline **two** methods of securing nuts in order to prevent loosening due to vibration.
- (k) Why are *factors of safety* critically important in the design and manufacture of a helicopter?
- (l) Identify **three** crystal point defects.

- (m) Describe the relationship between the cooling curve **A** and the thermal equilibrium diagram **B** shown.



**Section B – 50 Marks**

Answer **all** of the following:

- (n) Outline the benefits for using accelerometer technology in **each** of the following applications:

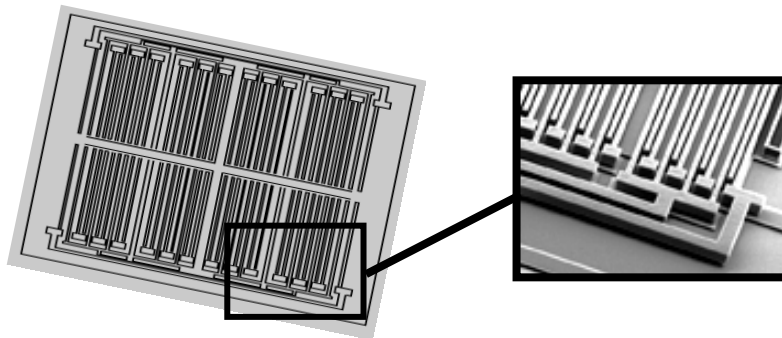
- (i) mobile phone;
- (ii) car safety.



- (o) Explain, with the aid of suitable diagrams, **any three** of the following types of movement used in an accelerometer:

- (i) Acceleration;
- (ii) Vibration;
- (iii) Shock;
- (iv) Tilt;
- (v) Rotation.

- (p) A micro electro-mechanical systems (MEMS) accelerometer is illustrated in the diagram below. Describe the principle of operation of this type of accelerometer.



- (q) Explain **any two** of the following:

- (i) The factors to be considered when selecting an accelerometer for use in protecting a laptop computer;
- (ii) Piezoelectric accelerometer;
- (iii) How the distribution of hot gas may be used as a sensing element in an accelerometer.

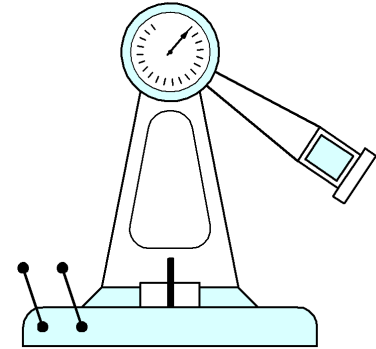
- (r) The accelerometer will measure both static and dynamic forces on items such as the computer game controller shown. Distinguish clearly between *static* and *dynamic* forces.



**Question 2.**

**(50 marks)**

- (a) (i) Outline **two** reasons for the mechanical testing of metals to the point of destruction.
- (ii) Describe the main features of the mechanical test represented in the diagram, with reference to the following:
- Purpose of the test
  - Principle of operation.



- (b) The following results were obtained from a tensile test on a cold-worked brass specimen. The test specimen was 16 mm in diameter with a gauge length of 80 mm.

<b>Load (kN)</b>	23	46	69	82	89	94	102	110	123	131	136	139	132	118
<b>Extension(mm)</b>	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0	1.5	2.0	2.5	3.0	4.0	4.3

Using the graph paper supplied, plot the load-extension diagram and determine:

- (i) The ultimate tensile strength (UTS);
- (ii) The 0.1% proof stress.
- (c) Describe, with the aid of suitable diagrams, **each** of the following non-destructive tests (NDT):
- (i) Eddy current testing;
- (ii) Radiography (x-ray) testing.

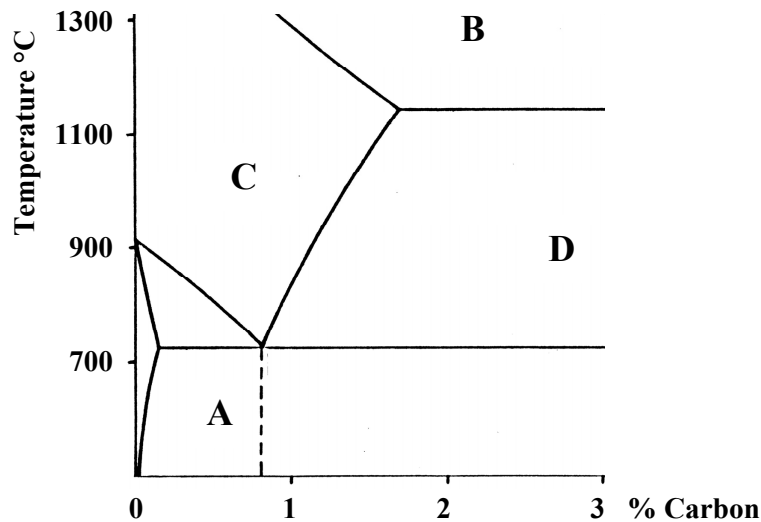
**Question 3.**

**(50 marks)**

**(a)** Select **any two** of the following:

- (i)** Compare the impact of soaking with the impact of water cooling in heat treatment;
- (ii)** Distinguish between the optical pyrometer and the thermo-electric pyrometer;
- (iii)** Describe the normalising process.

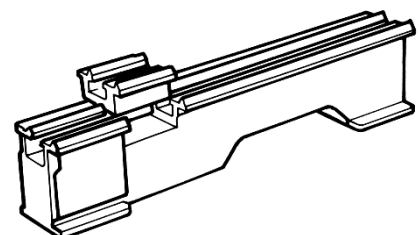
**(b)** A simplified section of the iron-carbon equilibrium diagram is shown:



- (i)** Identify the regions labelled **A**, **B**, **C** and **D**.
- (ii)** Describe, with the aid of a diagram, the crystal structure of martensite.

**(c)** The machined guideways of the lathe bed shown will be subjected to wear.

- (i)** Identify a suitable heat treatment process to prevent wear on the guideways.
- (ii)** Describe, with the aid of suitable diagrams, this heat treatment process.



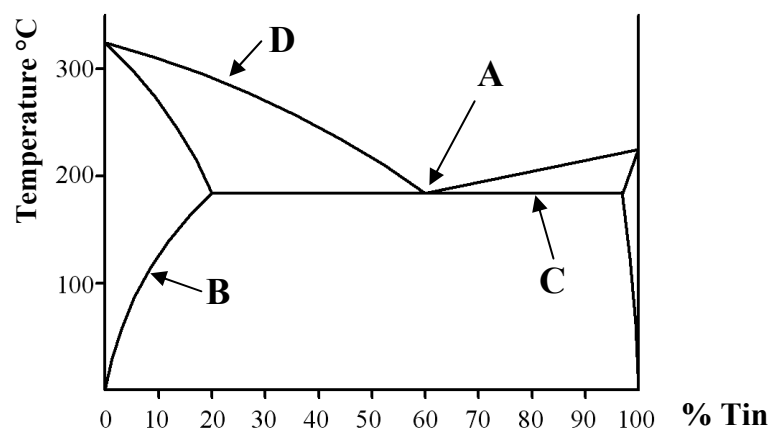
**Question 4.**

**(50 marks)**

**(a)** Explain **any two** of the following:

- (i)** Dislocation defect;
- (ii)** Age hardening;
- (iii)** Intermetallic compound;
- (iv)** Eutectoid point.

**(b)** The lead-tin equilibrium diagram is shown below.



- (i)** Identify the point **A** and the lines **B**, **C** and **D**.
- (ii)** Describe the main features of the diagram.
- (iii)** Determine, from the diagram, the composition of the phases at **250°C** for the alloy at **30% tin**.

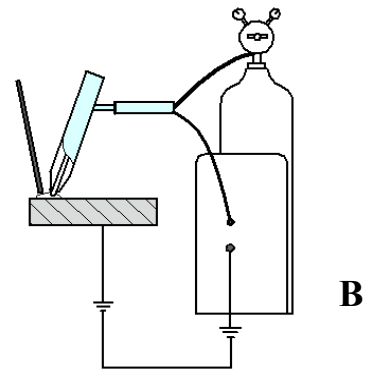
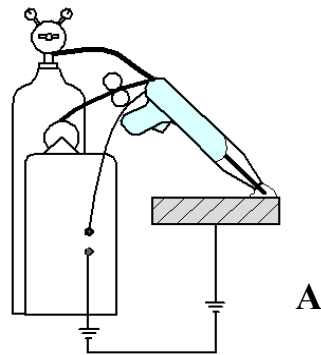
**(c)** Describe **any two** of the following:

- (i)** Solid solution alloy;
- (ii)** Eutectic alloy;
- (iii)** Partial solubility alloy.

**Question 5.**

**(50 marks)**

(a) Two industrial welding processes are illustrated at **A** and **B** below.



- (i) Name the **two** welding processes;
- (ii) Identify **one** application for **each** process;
- (iii) Describe the principles of operation for **any one** of these welding processes.

(b) Answer **any three** of the following:

- (i) Describe **three** important safety features integrated into the equipment used for oxyacetylene welding;
- (ii) State **two** functions of the slag produced in manual metal arc welding;
- (iii) Identify **one** use for submerged arc welding (SAW);
- (iv) Describe the principle of resistance welding.

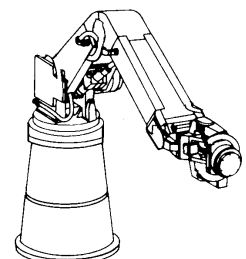
(c) Describe, with the aid of suitable diagrams, the main features of **one** of the following:

- (i) Electro-slag welding;
- (ii) Oxyacetylene welding.

**OR**

(c) Outline the advantages of using robotic control for **each** of the following engineering applications:

- (i) Spray painting vehicle body parts;
- (ii) Testing gas pipes;
- (iii) Placement of electronic components on circuit boards.

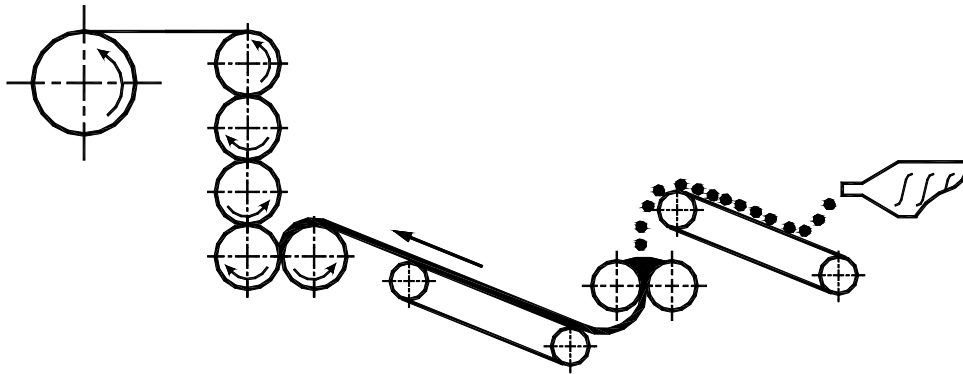




**Question 6.**

**(50 marks)**

- (a) A polymer manufacturing process is shown below.



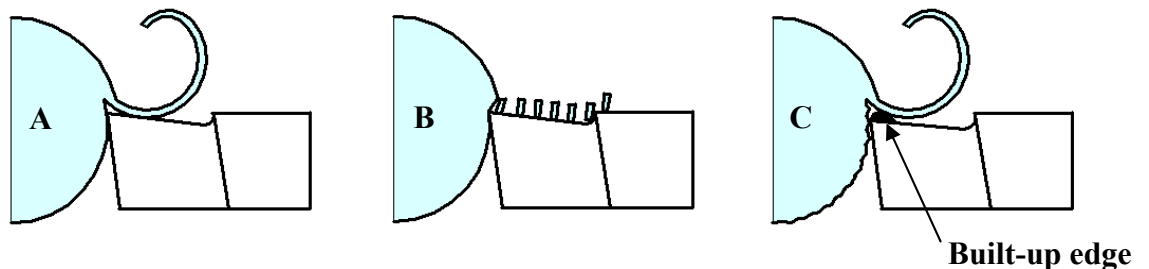
- (i) Name the process and describe the principle of operation;
- (ii) Identify **one** component produced by this process.
- (b) Differentiate between thermoplastics and thermosetting plastics, making reference to:
- (i) Chemical bonding;
- (ii) Internal structure;
- (iii) Properties.
- (c) Explain **any three** of the following in relation to polymers:
- (i) Stabiliser;
- (ii) Glass transition temperature;
- (iii) Condensation polymerisation;
- (iv) Elastomer;
- (v) Elastic memory in acrylic sheet.

**Question 7.**

**(50 marks)**

- (a) Answer **any three** of the following:
- (i) Identify **two** cutting tool materials used on a centre lathe;
  - (ii) Describe the process of up-cut milling;
  - (iii) Explain the differences between forming and generating;
  - (iv) Outline **two** reasons for wheel dressing a grinding wheel;
  - (v) Distinguish between a clearance fit and an interference fit.

- (b) The main types of material chip formed in metal cutting are illustrated below.



- (i) Identify the type of chip formed at **A** and the type of chip formed at **B**.
  - (ii) Describe the type of material that results in the chip formed at **A** and the type of material that results in the chip formed at **B**.
  - (iii) Suggest **three** safety precautions that would minimise the formation of a built-up edge as shown in **C**.
- (c) Describe, with the aid of suitable diagrams, the essential features of **one** of the following:
- (i) Magnetic chuck;
  - (ii) Four-jaw chuck.

**OR**

- (c) (i) Explain the term CNC.
- (ii) Describe the use of CNC technologies with reference to each of the following:
- Efficiency
  - Accuracy
  - Cost.

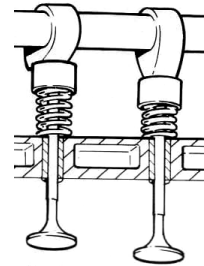
**Question 8.**

**(50 marks)**

(a) Name and describe the operation of **any one** of the mechanisms shown:



(i)

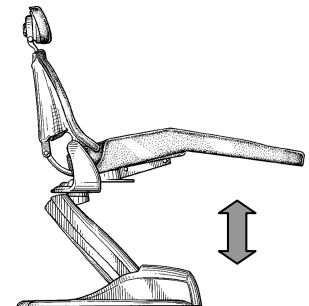


(ii)

(b) Explain **any three** of the following:

- (i) The use of bevel gears;
- (ii) Double-acting cylinder;
- (iii) Clutch;
- (iv) The function of an idler gear;
- (v) Capacitor.

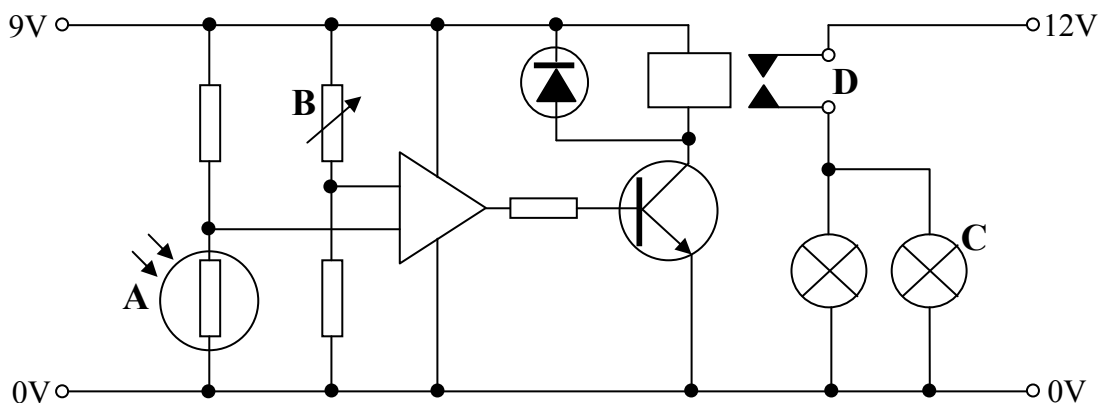
(c) Describe, with the aid of suitable diagrams, a mechanism to control the vertical movement of the dental chair shown.



**OR**

(c) The circuit shown is used to automatically turn on car parking lights:

- (i) Identify the electronic components **A**, **B**, **C** and **D**.
- (ii) Describe **two** functions of component **D** in this circuit.



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